TCW JIP Study
Status Update: Q3 2020

EPA Region 4 and Region 6
September 29, 2020

Agenda

Time	Topic
2:00-2:05	Meeting Objectives
2:05-2:10	Overview
2:10-2:50	JIP Study Update • Data Collection • Study Plan Modifications
2:50-3:00	Wrap-up and Questions
3:00	Adjourn

Meeting Objectives

- Provide EPA with Q3 2020 update on status of the TCW Fluid JIP study:
  - New JIP study data.
  - Request EPA approval of JIP study plan modifications.

Overview

- **Current Status**:
  - 25 discharge sampling events were scheduled for Year 1. 24 samples were collected because the well stopped producing at one location.
  - Acute 48-hour static-renewal WET testing:
    - 20 samples were WET tested with the established protocol.
    - 3 samples had properties that required a modified WET protocol (sample mixing).
    - 1 sample unexpectedly broke into two phases and will be tested with a water accommodated fraction (WAF) protocol.
- **Issues**:
  - Proposed laboratory protocol changes and preparation of an interim Year 1 Interpretive Report presenting findings to date are departures from approved plan.
  - EPA approval is requested for study plan changes.
- **Next Steps:**
  - Resume sampling in advance of EPA approval of plan changes.
  - Year 1 Interim Report targeted for end of Q1 2021. Final Interpretive Report targeted for October 2021.

Updated JIP Study Data

Acute WET Test Overview

- 25 samples were planned for collection in 2020; 1 sample could not be collected; 4 samples could not be analyzed with standard WET test procedures.
- WET test organisms are *Americamysis bahia* (Mysid) and *Menidia beryllina* (Inland silverside minnow).
- WET test endpoints: a 48-hour (48-H) no observed effect concentration (NOEC); a lowest observed effect concentration (LOEC); a 25% inhibition concentration (IC25); and a median lethal concentration (LC50).
- WET is variable: 48-H LC50s range from <0.1 to >50 percent effluent.

WET Test Endpoint Data

Sample	TCW Category	Difficult to Analyze Sample?	*Menidia beryllina (% Effluent)*				*Americamysis bahia (% Effluent)*			
			NOEC	LC25	LOEC	LC50	NOEC	LC25	LOEC	LC50
HV63	I	No	2	3.05	6	4.11	0.3	0.42	0.8	0.54
JK70	III	No	0.8	2.3	2.6	3.57	0.8	1.24	2.6	1.69
RD67	I	No	2	3	6	4	0.3	0.46	0.8	0.61
RU61	I	No	0.8	1.51	2	2.54	0.3	0.44	0.8	0.57
XP62	I	No	2	2.92	6	3.95	0.3	0.44	0.8	0.57
NY50	III	No	6	9	18	12	2	3	6	4
LC54	I	No	2	3	6	4	2	2.94	6	4.12
AU71	I	No	0.3	0.45	0.8	0.6	0.3	0.46	0.8	0.66
YO64	III	Yes. Frac. gel.	0.1	0.14	0.3	0.2	<0.1	0.03	0.1	0.05
FP89	III	No	0.3	0.41	0.8	0.54	<0.1	0.06	0.1	0.13
ZG57	I	No	50	>50	>50	>50	18	26.5	>50	35.2
GQ67	III	No	0.8	1.05	2	1.37	0.3	0.43	0.8	0.56
YU91	III	Yes. Frac. gel.	6	9.64	18	13.3	0.1	0.15	0.3	0.2
LX98	III	No	2	3	6	4	0.8	1.1	2	1.4
IS88	III	No	0.8	1.1	2	1.4	0.3	0.55	0.8	0.8
RU72	III	Yes. Proppant beads.	0.3	0.45	0.8	0.6	0.8	1.08	2	1.39
IH80	III	Yes. Well cleaner.	Sample is being evaluated with a water accommodated fraction (WAF) because of a separate phase.							
BT52	III	No	18	25.4	50	33.6	6	9.08	18	12.2
SH87	III	No	18	26	50	34	6	9.53	50	13.1
EP57	I	No	6	13.5	18	23.3	18	21.8	50	31.2
TR84	I	No	6	11	18	16	2	6	6	10
WW67	Sample could not be collected because the well stopped producing.									
RC74	III	No	6	9	18	12	6	8.82	18	12.4
OD76	III	Yes. Frac. gel.	6	8.77	18	11.9	<0.1	0.07	0.1	0.15
TF74	III	No	0.1	0.15	0.3	0.2	0.1	0.14	0.3	0.2

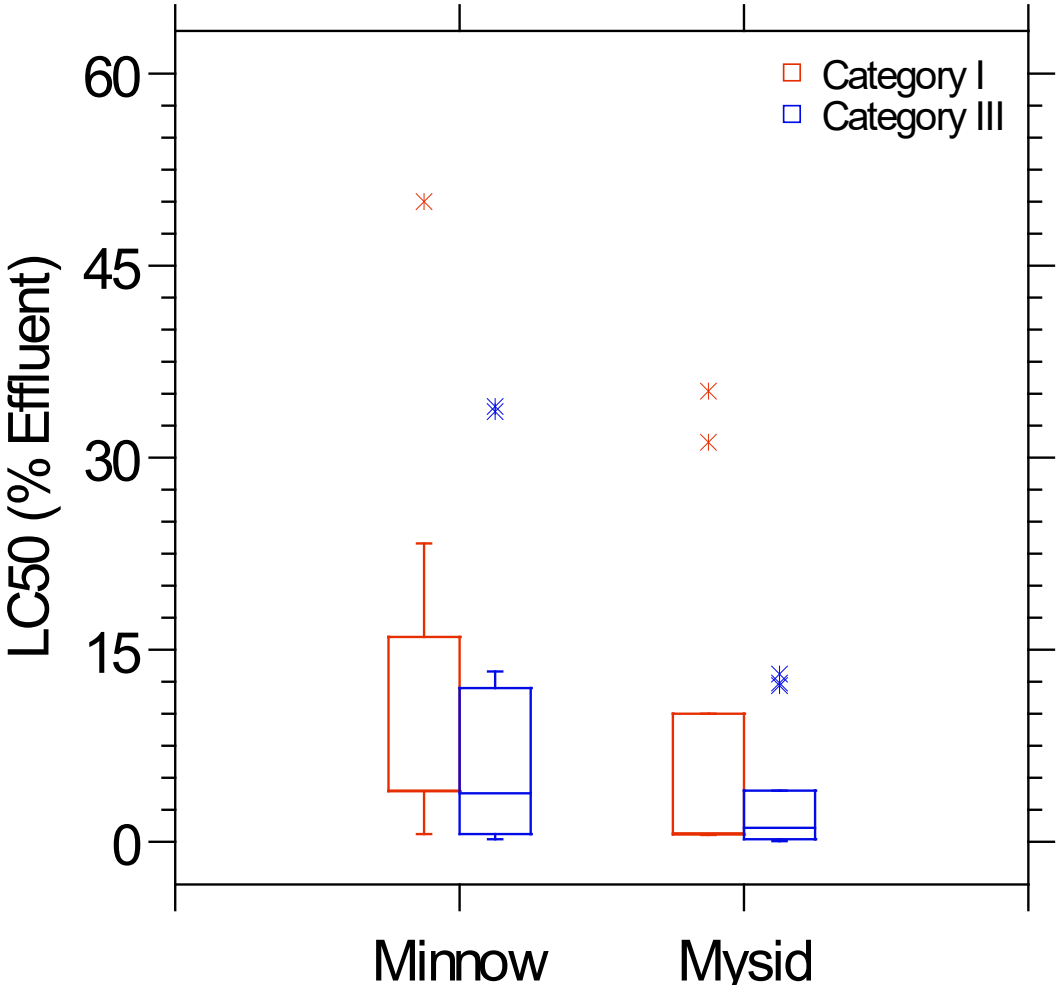
Notes:
NOEC; no observed effect concentration.
LC25; 25 percent (%) lethal concentration.
LOEC; lowest observed effect concentration.
LC50; 50 percent (%) lethal concentration.

48-H LC50 Data (All Samples)

Statistic	48-H LC50 (% Effluent)	
	Mysid	Inland silverside minnow
Sample Size	23	23
Min.	0.05	0.2
Max.	35.2	>50
Arith. Mean	5.7	10.3
Std. Dev. (SD)	9.7	13.2
C.V.	170%	128%

Notes: [1]. C.V.; coefficient of variation where C.V.= $\frac{SD}{Arith.Mean}$.

48-H LC50 Data (TCW Category I/III)



Notes: TCW Category I sample size = 9; TCW Category III sample size = 14.

Timing of Sample Collection

Species	Flow-Back Operation w/End-of-Pipe Treatment (Duration = 16 hours)			Completion/Frac. fluid Reverse-out (Duration = 3.5 hours)		
	48-H LC50 (% Effluent)			48-H LC50 (% Effluent)		
	Begin	Middle[1]	End	Begin	Middle	End
Minnow	23.3	16	Sample could not be collected[2]	12	11.9	0.2
Mysid	31.2	10		12.4	0.15	0.2

Notes: [1]. According to Operator, the granular activated carbon (GAC) filters were spent.
[2]. Well stopped producing.

Laboratory Analytical Data (at the Critical Dilution)

- **Category I:** Average CD=0.44%. 24 parameters not detected in any sample, e.g., NH3-N, As (diss.), total/dissolved metals (Cr, Pb, and Ni), and 16 polycyclic aromatic hydrocarbons (PAHs). 16 parameters with 100% detection frequency, e.g., hardness; alkalinity; TDS; total metals (Ca, Mg, Hg, K, and Na), dissolved metals (Ca, Mg, K, and Na); and inorganic anions (Br, Cl, and SO4).
- **Category III:** Average CD=0.38%. 22 parameters not detected, e.g., total/dissolved metals (Cr, Pb, and Ni); and 16 PAHs. 16 parameters with 100% detection frequency are identical to Category I samples.
- **Long-term flowback**: Average CD=0.19%. 36 parameters were not detected, e.g., PAHs, total/dissolved zinc. 21 parameters exhibited 100% detection frequency, e.g., total/dissolved Ca, bromide.
- **Completion/frac. fluid reverse-out**: Average CD=0.33%. 33 parameters were not detected, e.g., PAHs, zinc, cadmium. 18 parameters exhibited 100% detection frequency, e.g., potassium, calcium, sulfate.

JIP Study Plan Modifications

JIP Study Plan Modifications

- EPA approval is requested for the following modifications to the JIP study plan:
  - Revised laboratory protocols for difficult to analyze Category III fluids: (1) sample mixing for Category III gels, and (2) WAF.
  - Interim Year 1 report for Q1 2021.

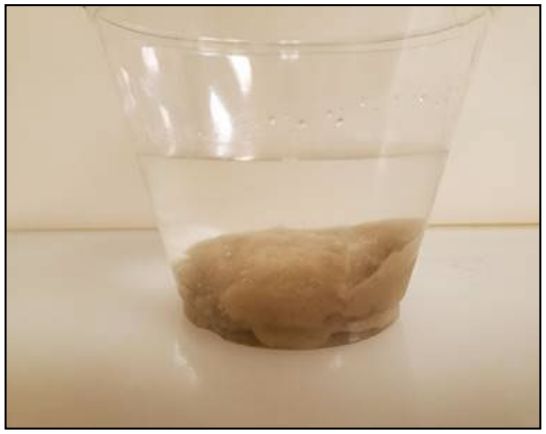
Sample Mixing

- **Category III gels**: WET testing for Category III gel samples cannot currently be performed consistent with the approved study plan. Changes to the plan require EPA approval:
  - **What is the recommended approach?** The recommended approach is gentle mixing. Category III gels mix uniformly with laboratory control seawater (LCSW) after prolonged stirring.
  - **Has a laboratory protocol been developed?** Yes. The TCW study team has developed an alternative toxicity testing protocol for gels.
  - **What is the rationale for sample mixing?**
    - Has been used successfully on the JIP study samples collected so far.
    - Gentle mixing on a magnetic stir plate is not anticipated to alter toxicity.
    - Mixing is a conservative approach that will maximize water column exposure of WET test organisms.

Sample Mixing

Sample of a Category III spacer.

Example of frac. gel with embedded proppant beads.



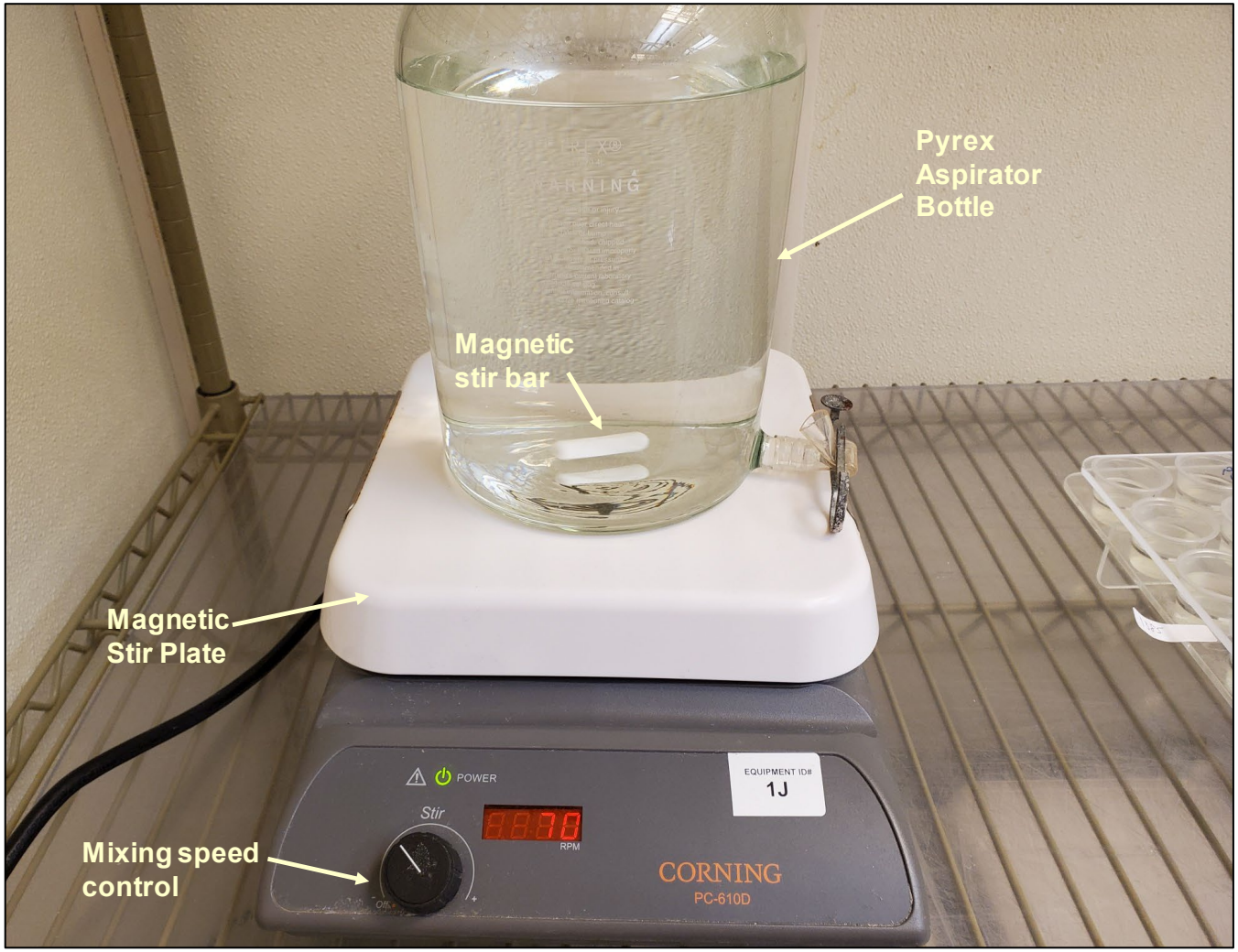
Sample of the Category III spacer after placing in water for illustration.

Sample of CaCl2 and CaBr2 brine/frac. gel.

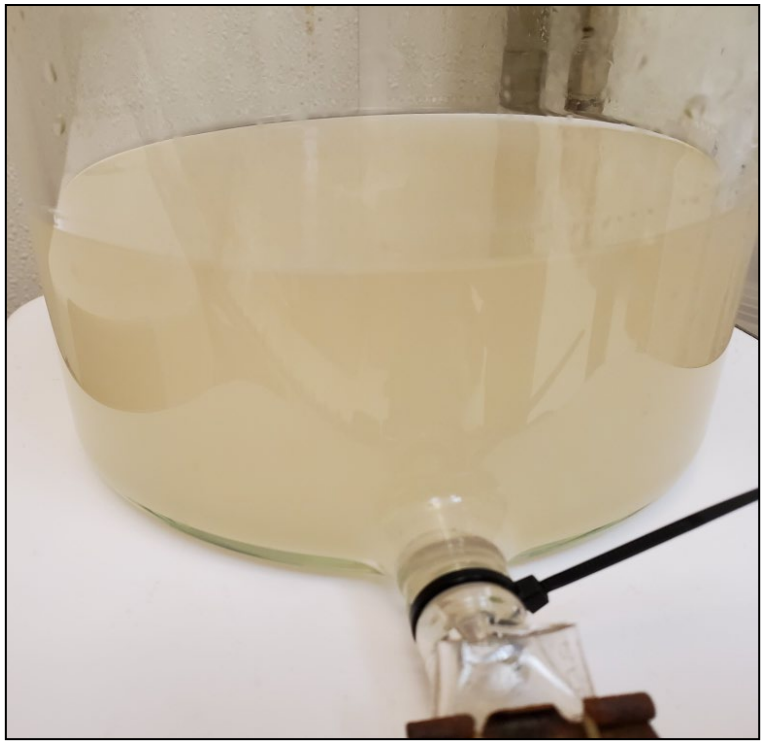
Three samples with frac gels were collected.

Gels require mixing before WET testing can be conducted.

Sample Mixing



Sample Mixing



Gel sample immediately after turning magnetic stir plate off.

Samples containing frac gels were homogenized and then subjected to WET testing.

The solution was gently mixed for five hours using a magnetic stir plate.

The sample was “water-like” after mixing and could be subjected to WET testing.

Water Accommodated Fraction

Side view of separate phases after settling.

One sample, reported to contain a cleaning spacer product, formed two liquid phases when mixed with laboratory seawater after >8 hours.

The toxicity of this sample is being evaluated with a water accommodated fraction (WAF).

Due the exceptional nature of this sample, the revised study plan calls for any additional samples showing this behavior to be noted in quarterly reports to EPA and the final project report.

Water Accommodated Fraction

Step 1. Prepare Individual WAFs

WAF (%)	TCW Volume (mL)	LCSW Volume (mL)
0.1	3.6	3,596
0.3	10.8	3,598
0.8	28.8	3,571
2	72	3,528
6	216	3,384
18	648	2,952

WAF loadings.

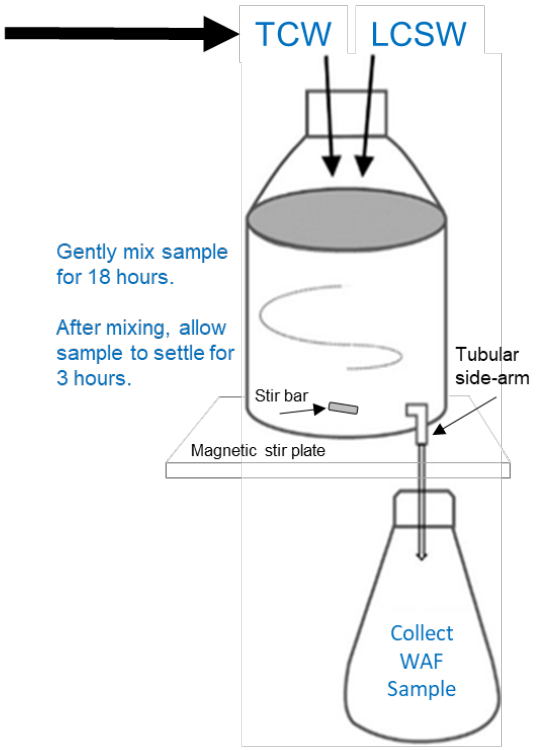


Illustration of WAF steps.

Step 2. Conduct Definitive 48-h WAF Tests

Interim Year 1 Report

- The Year 1 Interim Report will be submitted to EPA by the end of Q1 2021.
- Consistent with the study plan, the interim report will:
  - Address study questions regarding TCW discharge quality and the potential for TCW discharges to cause acute aquatic toxicity towards aquatic biota.
  - Support decision-making regarding the collection of TCW Category I and TCW Category III samples in Year 2.
- A final Interpretive Report, discussing findings from sampling conducted in Year 2, will be submitted to EPA in October 2021.

Wrap Up and Questions

- Wrap-up.
- Questions?

Adjourn